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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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[X] *Additional Inventors are being named on the* 1 *separately numbered sheets attached hereto*

TITLE OF THE INVENTION (500 characters max)

ORIENTED STRAND BOARD

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Respectfully submitted,

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Date Apr 1, 2004

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REGISTRATION NO. *(if appropriate)* 26,588

Docket Number: 030268-0309108

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Docket Number	030268-0309108

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ORIENTED STRAND BOARD

The invention is directed to an Oriented Strand Board (OSB), comprising a core layer and two face layers, whereby the face layers comprise an adhesive composition.

The oriented strand boards that are commercially prepared at the moment comprise a core layer of wood strands combined with an adhesive composition, covered by two face layers of wood strands combined with an other adhesive composition. The strands in the OSB typically have the following dimensions; length between 5 and 150 mm, width between 1 and 50 mm and thickness between 0.1 and 2 mm. The core can form between 10 and 90 wt.% of the OSB, preferably between 40 and 60% of the OSB. The adhesive composition in core layer of the known OSB comprises 2-6 wt% (dry resin/dry wood) of a polymeric methylene diphenyl diisocyanate (pMDI) or a phenol formaldehyde (PF) resin. The adhesive composition in the face layers comprises a melamine-urea-formalydehyde (MUF) resin, and may also comprise a small amount of phenol or a phenol formaldehyde resin or pMDI resin with a release agent added thereto. The face layers have a resin content of typically 9-12 wt% dry resin/dry wood for MUF and typically 2-6 wt% dry resin/dry wood for PF. These known OSB's meet the requirements of OSB/3 in the EN 300 standards.

It is a disadvantage of the known OSB's that a relatively high amount of resin is necessary, in particular in the face layers, in order to ensure that the OSB/3 standards are met.

It is the objective of the present invention to overcome said disadvantage.

Said objective is achieved in that that the adhesive composition in at least one of the face layers comprises a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0. Preferably, the adhesive composition in both face layers comprises a resin according to the invention.

An advantage of the OSB according to the invention is that an OSB meeting the OSB/3 standards can be made with a lower amount of resin in the face layers when the known type of resin for this application is used. By application of the

resin as defined above for the preparation of at least one of the face layers of the OSB the amount of resin that has to be used for the face layer to make an OSB that meets the OSB/3 standards can be reduced to as little as between 2.5-8 wt% dry resin/dry wood. As a result of this the cost price of the OSB will be lower than for a known OSB as described above. Alternatively, if the OSB according to the invention comprises the same amount of resin in at least one face layer, it will show superior properties compared to the known OSB, in particular relating to internal bond strength and swelling after contact with boiling water.

The resin composition according to the invention comprises melamine and formaldehyde. The melamine and formaldehyde are present in the resin composition in a molar ratio of 1:0.8-4.0, preferably 1:1.0-3.0. As is commonly known, resins are cured in order to achieve their final properties. The wording 'resin' in the present invention relates to the resin in both uncured condition as well as in cured condition in the end product, when it is part of the OSB.

The resin is normally made by mixing dry melamine powder with an aqueous solution of formaldehyde. This solution having a formaldehyde concentration of for instance 30-55 wt% of formaldehyde.

Further the resin composition can contain urea and/or aromatic hydroxyl compounds.

When urea is present in the resin composition the molar ratio of melamine to urea is 1: 0-2.0, preferably 1:0-1.5. When aromatic hydroxyl compound is present in the resin composition the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0, preferably 1:0-1.0.

Examples of aromatic hydroxyl compounds are resorcinol, hydrochinon or bisphenol A. Preferably however phenol is used as the aromatic hydroxyl compound.

The urea can be introduced in the resin composition by adding solid urea or by adding a urea solution in water and mixing it with the melamine and the formaldehyde solution. Also an aqueous solution of formaldehyde and urea can be used in combination with the melamine powder.

Phenol can be added as such when the resin composition is prepared or as a formaldehyde/phenol precondensate.

A non-limiting indication of the preparation of the resin that is part of the OSB according to the invention is as follows: the components that make up the

resin composition are added to each other and mixed at a temperature of 20 to 40°C. Thereafter the temperature is raised to a temperature between 70 and 100°C. The pH-value of the mixture is preferably between 7.0 and 10.0. Under these conditions the mixture reacts, i.e. condensation taking place, until the viscosity of the resin composition is between 10 and 1000 mPas, preferably between 10 and 500 mPas. Thereafter the resin composition is cooled to 20-75°C, preferably to room temperature. The pH of the cooled resin composition will typically be between 7 and 10.

Another non-limiting indication of a method for preparation of the resin composition that is part of the OSB according to the invention is a method that comprises stepwise dosing of the components. For example, urea can be added during or after the condensation.

To adjust the pH of the resin composition the normal additives to create alkaline conditions can be used, like alkali or earth alkalihydroxydes, preferably in the form of their aqueous solutions, tertiary amines, like for instance tributylamine or triethylamine, or tertiary alkanolamines, like for instance triethanolamine and methyldiethanolamine.

The viscosity of the aqueous resin composition is typically at 20°C 10-800 mPas and has a solids content of between 50 and 70%.

The products can usually be stored for a couple of weeks at 20°C. As is known, small amounts of other additives can also be added to the resin.

The resin composition according to the invention has surprisingly good properties when applied as the resin in the face layers of oriented strand board (OSB). A process thereto is described below.

To be applied in a face layer, the resin is usually mixed with a catalyst or hardener, whereby an adhesive composition is formed. As a hardener for instance ammoniumsulphate is commonly used, in an amount of up to 5 wt% dry hardener/ dry resin. However, other hardeners can also be used; for instance ammonium chloride or ammonium nitrate. The adhesive composition according to the invention may optionally comprise one or more other resins. During the preparation of the adhesive composition also waxes can be applied; this is commonly done in order to enhance the moisture resistance of the OSB.

After addition of the catalyst the adhesive composition is normally used within a time frame of a few hours in the production of an OSB; the adhesive composition is sprayed on the wood strands to coat the wood strands with it. The wood

strands usually have a length between 5 and 200 mm, preferably between 20 and 150 mm, more preferably between 40 and 140 mm, in particular between 60 and 130 mm and most preferably between 80 and 120 mm. The wood strands usually have a width between 1 and 60 mm, preferably between 5 and 50 mm, more preferably between 10 and 40 mm, in particular between 14 and 30 mm and most preferably between 18 and 25 mm. The wood strands usually have a thickness lying between 0.1 and 2 mm, preferably between 0.2 and 1.5 mm, more preferably between 0.3 and 1.2 mm, in particular between 0.4 mm and 1 mm, most preferably between 0.6 and 0.8 mm. The adhesive composition is cured / hardened upon heating, thereby binding the wood strands to each other. Heating and curing / hardening takes place when pressing the final OSB material.

The process for the production of an OSB is known in general, and described in for instance: "Holzwerkstoffe und Leime, M. Dunky and P. Niemz, p 133-135, Springer-Verlag, 2002" and in "Taschenbuch der Spanplatten Technik, Deppe & Ernst, p 258-266, 1991, DRW Verlag".

A method of making the oriented strand boards according to the invention is by spraying the adhesive composition according to the invention onto the wood strands for at least one of the face layers of the OSB, preferably in both face layers. In order to achieve a quality according to the OSB/3 standard, the amount of resin in the said face layer or layers can be 2.5 to 8 wt% dry resin/dry wood.

The core material is prepared by coating wood strands, normally with polymeric methylene diphenyl diisocyanate (pMDI) or phenol formaldehyde (PF) resin or with an other resinous material, for instance with the adhesive composition according to the invention. When the resin composition according to the invention is used in the core layer instead of pMDI the amount of resin can be about the same as for pMDI or lower in the core layer, so that the costs for the resin in the core layer are lower. Usually, the wood strands in the core layer are smaller than the wood strands in the face layers.

Thereafter an OSB is prepared by first scattering – while usually achieving an orientation – the face layer material, thereafter the core layer material and then again a layer of face layer material, followed by hot pressing this to an OSB. The pressing can be continuous or batch wise. In the core layer and the face layers wood strands of different size and orientation can be used. Typically, the wood strands in the core layer have smaller dimension(s) and less orientation than the wood strands in the face layers.

As described here, an OSB has three layers – a core and two face layers. It is also known that an OSB having 4 or more layers may be prepared, for instance by introducing at least one layer between the core and at least one face layer.

Typical known press conditions are 1-7 MPa, 150-270°C during 3-12 sec/mm, preferably 5-10 sec/mm. As is known to those skilled in the art, press times are given in seconds per mm of OBS thickness.

In summary, a process for the preparation of an oriented strand board (OSB) according to the invention may comprise the following steps:

a) preparing an adhesive composition comprising a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0;
b) treating wood strands with the adhesive composition;
c) scattering adhesive-treated wood strands for a face layer, a core layer on top of the face layer, and again a face layer on top of the core layer, whereby the wood strands of at least one face layer were treated with the adhesive composition prepared in a);
d) pressing the wood strands, to form an OSB.

Preferably, the wood strands of both of the face layers are treated with an adhesive composition as prepared in step a). Preferably, the core layer is also treated with an adhesive composition as prepared in step a).

The OSB's according to the invention comprise an amount of urea – typically for the most part in bonded form – in at least of face layer. Preferably, at least one face layer of the finished OSB according to the invention comprises an amount of urea of 0-0.025 kg/kg face layer, more preferably 0-0.015 kg/kg face layer. The amount of urea in the face layer can be determined with known methods such as for instance Raman spectroscopy or solid state NMR. The reference to urea in an OSB face layer within the context of the present invention means urea as such and in bonded form in a resin.

The finished OSB according to the invention can meet the requirements for an OSB/3 material as are laid down in the EN 300 requirements. Typical requirements herein are the requirements for thickness swelling and internal bond after boiling.

The thickness swelling is determined according to EN 317 and must be lower than 15% for an OSB meeting the OSB/3 standard. The internal bond after boiling is determined according to EN 321 and EN 319. The minimum values differ with the OSB thickness and are:

OSB thickness (mm)	Internal bond (N/mm^2)
6-<10	>0.15
10-<18	>0.13
18-<25	>0.12

The invention is elucidated further by means of the following examples.

Example I

Resin preparation

A solution of a 50 wt.% solution of formaldehyde in water and a phenol formaldehyde precondensate were added to each other and stirred. The mixture was adjusted with NaOH to a pH of 9. Melamine was added at room temperature.

Thereafter the temperature was raised to 90 °C. Dissolution of the melamine and condensation takes place until the water tolerance was 1.5-2. The water tolerance was determined at 20°C.

Thereafter the mixture was cooled. At 60 °C the urea was added and thereafter the mixture was cooled further to room temperature during stirring.

The resin composition contained per mol of melamine: 2.1 mol formaldehyde; 0.26 mol urea and 0.16 mol phenol.

The resin properties were:

Viscosity 300 mPas (at 20 °C),

pH = 10,

Solid content = 62.5 %,

Gel time = 50 sec.,

Water tolerance = 1.5

OSB preparation

The adhesive composition for the two face layers of the OSB was made by adding ammonium sulphate as hardener to the resin, and 1 wt.% (based on the 'wet' resin) of a wax emulsion. Then the adhesive composition was sprayed onto the wood strands.

The face layer for the OSB contained 5.8% dry resin/ dry wood and 1% dry hardener/dry resin.

The adhesive composition for the core layer was also sprayed on the wood strands. The core layer for the OSB contained 3.0% dry pMDI/dry wood. Thereafter an OSB was made by scattering a layer of the wood strands for the face layer, than scattering a layer of wood strands for the core layer and thereafter again scattering a layer of wood strands for the second face layer.

The weight ratio core layer to face layers was 50/50.

The OSB was pressed with a press factor of 9.4 sec/mm, an average temperature of 235°C and a pressure of 5 MPa.

An OSB was made with a thickness of 22 mm having a thickness swell of 8.9% and an internal bond value of 0.155 N/mm^2.

Example II

With the same method as described for example I an OSB was made with a thickness of 18 mm. For this OSB the face layer contained 6.0% dry resin/ dry wood and 1.5% dry hardener/dry resin.

The OSB was pressed with a press factor of 9.2 sec/mm, an average temperature of 235 °C and a pressure of 5 MPa.

An OSB was made with a thickness swell of 11.0 % and an internal bond value of 0.15 N/mm^2.

Comparative experiment

Resin preparation

A solution of a 50 wt.% solution of formaldehyde in water and a phenol formaldehyde precondensate were added to each other and stirred. The mixture was adjusted with NaOH to a pH of 9. Melamine was added at room temperature.

Thereafter the temperature was raised to 90 °C. During this phase, when the temperature had reached 82°C, urea was added. Dissolution of the melamine (and

urea), and condensation took place until the water tolerance was 3. The water tolerance was determined at 20°C. During condensation, the pH was kept at 9 by addition of NaOH; when water tolerance of 3 was reached, the pH was raised to 10. Thereafter the mixture was cooled to room temperature.

The resin composition contained per mol of melamine: 4.17 mol formaldehyde; 2.27 mol urea and 0.2 mol phenol.

The resin properties were:

Viscosity 300 mPas (at 20 °C),

pH = 10,

Solid content = 62.5 %,

Gel time = 50 sec.,

Water tolerance = 3

OSB preparation

The adhesive composition for the two face layers of the OSB was made by adding ammonium sulphate as hardener to the resin, and 1 wt.% (based on the 'wet' resin) of a wax emulsion. Then the adhesive composition was sprayed onto the wood strands.

The face layer for the OSB contained 11 wt.% dry resin/ dry wood and 1% dry hardener/dry resin.

The adhesive composition for the core layer was also sprayed on the wood strands. The core layer for the OSB contained 3.0% dry pMDI/dry wood. Thereafter an OSB was made by scattering a layer of the wood strands for the face layer, than scattering a layer of wood strands for the core layer and thereafter again scattering a layer of wood strands for the second face layer.

The weight ratio core layer to face layers was 50/50.

The OSB was pressed with a press factor of 9.4 sec/mm, an average temperature of 235°C and a pressure of 5 MPa.

An OSB was made with a thickness of 22 mm having a thickness swell of 10% and an internal bond value of 0.14 N/mm^2.

As is evident from Example I and the comparative experiment, the OSB according to the invention has a much lower amount of resin in the face layers than the OSB prepared with a resin known for this purpose, and yet the properties of OSB according to the invention are at least as good as those of the known OSB.

CLAIMS

1. Oriented strand board (OSB), comprising a core layer and two face layers, whereby the face layers comprise an adhesive composition, characterised in that the adhesive composition in at least one of the face layers comprises a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0.
2. Oriented strand board according to claim 1, characterised in that in the resin composition the molar ratio of melamine to formaldehyde is 1:1-3.0, the molar ratio of melamine to urea is 1:0-1.5 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-1.0.
3. Oriented strand board according to claim 1 or 2, characterised in that the aromatic hydroxyl compound comprises phenol.
4. Oriented strand board according to any one of claims 1 – 3, wherein the core layer comprises an adhesive composition, characterised in that the adhesive composition in the core layer comprises a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0.
5. Oriented strand board according to any one of claims 1-3, characterised in that, the resin in the core layer is the same as the resin in the at least one face layer according to any one of claims 1-3.
6. Oriented strand board according to any one of the claims 1-3, characterised in that the amount of resin in the at least one face layer is 2.5-8 wt% dry resin/dry wood.
7. Oriented strand board according to any one of claims 1-3 or 6, characterised in that the amount of urea in a face layer is 0-0.025 kg/kg face layer.
8. Oriented strand board according to any one of claims 1-3 or 5, characterised in that the amount of urea in a face layer is 0-0.015 kg/kg face layer.
9. Oriented strand board according to any one of claims 1-7, characterised in that the OSB has a thickness swell lower than 15% according to OSB/3

standards.

10. Oriented strand board according to any one of claims 1-8, characterised in that the OSB has and an internal bond value after boiling that is according to OSB/3 standards.

11. Process for the preparation of an oriented strand board (OSB), comprising:

a) preparing an adhesive composition comprising a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0;

b) treating wood strands with the adhesive composition;

c) scattering adhesive-treated wood strands for a face layer, a core layer on top of the face layer, and again a face layer on top of the core layer, whereby the wood strands of at least one face layer were treated with the adhesive composition prepared in a);

d) pressing the wood strands, to form an OSB.

12. Process for the preparation of an OSB according to claim 11, wherein the wood strands of the face layers and of the core layer were treated with an adhesive composition as prepared in step a).

ABSTRACT

Oriented strand board (OSB), comprising a core layer and two face layers, whereby the face layers comprise an adhesive composition, wherein the adhesive composition in at least one of the face layers comprises a resin composition comprising melamine, formaldehyde, optionally urea and aromatic hydroxyl compounds, wherein the molar ratio of melamine to formaldehyde is 1:0.8-4.0, the molar ratio of melamine to urea is 1:0-2.0 and the molar ratio of melamine to aromatic hydroxyl compounds is 1:0-2.0.

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